According to a second aspect of the invention the block **50** uses the information stored in the second data file **49** to subtract the plasma emission signal from the illuminated interferometric signal. The block **50** then uses this information and the information stored in the first data file **47** to calculate the thickness of the film on the wafer **74** and the etch or deposition rate.

According to a third aspect of the invention, the intensity of the pulse generated by the flash lamp **35** is detected by the spectrograph **40** by means of optical fiber **62**. Information relating to variations in pulse intensity caused by, for example, aging of the flash lamp **35**, is stored in a third data file (not shown). The block **50** uses the information stored in the third data file to normalize the information of the first data file **47** for variations in pulse intensity. The block **50** then uses this normalized information and the information stored in the first data file **47** to calculate the thickness of the film on the wafer **74** and the etch or deposition rate.

The flash lamp **35** of the preferred embodiment is preferably a xenon flash lamp having a small arc size to more nearly approximate a point source for efficient coupling to the optical system of the invention. Advantageously, the xenon flash lamp provides a high energy pulse of short duration (on the order of one microsecond). Hence the integration time of the spectrograph **40** can be reduced and the effect of the plasma emission on the interferometric signal largely eliminated. Additionally, the average energy delivered to the wafer **74** is low. Further, by using a pulsed light source, the lifetime of the source can be extended.

The method and apparatus of the invention is preferably used with a system that is substantially transmissive to ultraviolet radiation. Optical viewing windows and collimators transmissive to ultraviolet radiation are well known in the art and their properties and arrangement in a plasma chamber will not be further described.

Although only a few embodiments of the present invention have been described in detail herein, it should be understood that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given therein, but may be modified within the scope of the appended claims.

We claim:

1. A process monitor for determining process parameters during a plasma etch process of a wafer, the process monitor comprising:

a flash lamp emitting a broad-band optical radiation;

a spectrograph responsive to optical radiation reflected from the wafer; and

a data processing element for processing a first signal from the spectrograph, the first signal representative of emitted optical radiation reflected from the wafer, and determining a process parameter.

2. A process monitor according to claim **1** further comprising a beam forming module operable to collimate the emitted optical radiation.

3. A process monitor according to claim **2** wherein the collimated optical radiation is incident normally to the wafer.

4. A process monitor according to claim **1** wherein a spectrograph integration period is synchronized to the flash lamp.

5. A process monitor according to claim **1** wherein a second signal representative of optical radiation reflected from the wafer during a period when the flash lamp is not emitting broad-band optical radiation is processed by the data processing element and subtracted from the first signal to determine a process parameter.

6. A process monitor according to claim **1** wherein a third signal representative of the intensity of the emitted radiation is processed by the data processing element to normalize the first signal.

7. A process monitor according to claim **6** wherein the normalized first signal is processed by the data processing element to determine the process parameter.

8. A process monitor according to claim **1** wherein the process parameter further comprises a thickness of a layer carried by the wafer.

9. A process monitor according to claim **1** wherein the process parameter further comprises an etch rate of a layer carried by the wafer.

10. A process monitor according to claim **1** wherein the process parameter further comprises a process endpoint.

11. A process monitor for determining process parameters during a plasma deposition process of a wafer, the process monitor comprising:

a flash lamp emitting a broad-band optical radiation;

a spectrograph responsive to optical radiation reflected from the wafer; and

a data processing element for processing a first signal from the spectrograph, the first signal representative of emitted optical radiation reflected from the wafer, and determining a process parameter.

12. A process monitor according to claim **11** further comprising a beam forming module operable to collimate the emitted optical radiation.

13. A process monitor according to claim **12** wherein the collimated optical radiation is incident normally to the wafer.

14. A process monitor according to claim **11** wherein a spectrograph integration period is synchronized to the flash lamp.

15. A process monitor according to claim **11** wherein a second signal representative of optical radiation reflected from the wafer during a period when the flash lamp is not emitting broad-band optical radiation is processed by the data processing element and subtracted from the first signal to determine a process parameter.

16. A process monitor according to claim **11** wherein a third signal representative of the intensity of the emitted radiation is processed by the data processing element to normalize the first signal.

17. A process monitor according to claim **16** wherein the normalized first signal is processed by the data processing element to determine the process parameter.

18. A process monitor according to claim **11** wherein the process parameter further comprises a thickness of a layer carried by the wafer.

19. A process monitor according to claim **11** wherein the process parameter further comprises a deposition rate of a layer carried by the wafer.

20. A process monitor according to claim **11** wherein the process parameter further comprises a process endpoint.

21. A method of monitoring a process and for determining process parameters during a plasma process of a wafer, the method comprising

providing a flash lamp emitting a broad-band optical radiation;

providing a spectrograph responsive to optical radiation reflected from the wafer; and

providing a data processing element for processing a first signal from the spectrograph, the first signal representative of emitted optical radiation reflected from the wafer, and determining a process parameter.

22. A method of monitoring a process as recited in claim 21 further comprising providing a beam forming module operable to collimate the emitted optical radiation.

23. A method of monitoring a process as recited in claim 22 wherein the collimated optical radiation is incident normally to the wafer.

24. A method of monitoring a process as recited in claim 21 further comprising synchronizing a spectrograph integration period to the flash lamp.

25. A method of monitoring a process as recited in claim 21 further comprising processing a second signal representative of optical radiation reflected from the wafer during a period when the flash lamp is not emitting broad-band optical radiation and subtracting the processed second signal to determine a process parameter.

26. A method of monitoring a process as recited in claim 21 further comprising processing a third signal representative of the intensity of the emitted radiation to normalize the first signal.

27. A method of monitoring a process as recited in claim 26 further comprising processing the normalized first signal to determine the process parameter.

28. A method of monitoring a process as recited in claim 21 wherein the process parameter further comprises a thickness of a layer carried by the wafer.

29. A method of monitoring a process as recited in claim 21 wherein the process parameter further comprises an etch rate of a layer carried by the wafer.

30. A method of monitoring a process as recited in claim 21 wherein the process parameter further comprises a deposition rate of a layer carried by the wafer.

31. A method of monitoring a process as recited in claim 21 wherein the process parameter further comprises a process endpoint.

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